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ABSTRACT

Teaching process data was collected on two levels for this long-range project. On one level it was collected as extensive data with the lesson as the analytical unit. On the other level, it was collected based on the single utterance within the lesson. The results indicate that the teaching pattern can be explained by the steering function of the pedagogical frames (objectives, class composition, time at disposition). The frames form the grammar of the classroom language as well as the pedagogical roles of the students. The theoretical explanation is formed in respect to curriculum theory and theory on teaching. (Author)

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PEDAGOGICAL FRAMES AND THE TEACHING PROCESS

A report from an emperical curriculum project.

Ulf P. Lundgren

Paper read at the AERA meeting in
New Orleans, 26 febr - 1 march 1973.

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Introduction

At AERA's meeting in Minneapolis 1970 a plan for a Swedish research project was presented (Dahllöf & Lundgren 1970). The project has been finished and the main purposes have been fulfilled, but the results have also raised new questions. At this meeting the outcome of our project will be presented in two ways. In the invitational address to the members of Devision B professor Dahllöf will discuss the consequences of our theoretical thinking for educational research. In this paper I will present the main theoretical model, the points of empirical verifications and the theoretical interpretations. On one hand this paper is a brief summary of a final report (Lundgren 1972) from the project. On the other hand it alludes to some lines of thought which are theoretical developments for future research. This latter aspect will be more analyzed and presented in a later report (Lundgren 1973). In some respects this paper may be looked upon as a link between a final report from a finished project and the plans for a new project.

Chapter 1. The framing of the problem

The history of sciences can on a cursory level be described as a development, starting in questions on things of far distance to man and going over to questions on familiar phenomena and everyday experiences. In wondering about the distant and the uncontrolled are questions formulated which give birth to science. This perspective gives one dimension in explaining the formalized theoretical level for natural sciences in comparison to social sciences. But even within a science it gives some hints for a description of the internal development as well.

The central phenomena in education - teaching - is in one sense the most unknown and in another sense the most known. As it is more difficult to ask relevant and theory deriving questions around familiar phenomena than around unfamiliar ones; theories on teaching are often built on weak empirical fundaments. Many theoretical models have been formulated from different assumptions about man and society. Models, that with few exceptions are prescriptive. But even prescriptions must be based in an understanding of the phenomena to be changed. This understanding is often hidden in assumptions based on personal experiences and perceptions of teaching. This is one of the central problems for the development of education as a science.

The demands for comprehensive and empirical theories on teaching form a point of intersection between two areas within education, curriculum theory and classroom discourse analysis. (cf Lundgren 1972, p. 19-80). In order to mirror our basic thinking I will very briefly touch on some basic problems and notions.

Curriculum Theories

A survey of curriculum theories is a thorny undertaking (cf Beauchamp 1961, 1968, Foshay & Beilin 1969, Johnson 1967). The field suffers from a lack of accurate definitions and a lack of common nomenclature. A series of theories within the social sciences, when placed in an educational context, have been called curriculum theories. The problem is even more troublesome when making international comparisons, when abstracting over

the general cultural development (cf Bellack 1969). In order to identify the critical points from our aspect I will just point on some features within curriculum theories developed in USA. The reader should have in mind that this discussion is done from the horizon of an European researcher. In order to identify some lines of thought within curriculum theories I will first touch on the notion of theory

In a theory, we abstract and reduce information - reduce various events to concepts that explain how the events are interrelated. As an abstraction, theory is dependent on how well the various concepts are delimited and on how unambiguous they are, as well as on to what extent the relations are formalized. (cf Kerlinger 1964, p. 11, 1969, p. 1127, Brodbeck 1963).

What distinguishes one theory about a phenomenon from another is the way of looking on the structure of the phenomena. On one hand we can define the structure through describing its parts and explaining the relation between the parts. On the other hand we can define the structure as a system of transformations. The first way is represented most within behavioral sciences (cf Zetterberg 1965). The other way is the essence of structuralism (cf Piaget 1968). For the sake of this discussion it is easiest to start with the first notion, I will later on develop the discussion over to the other notion. The central concepts then distinguish different theories from each other (cf Russell 1948). These concepts could be called miniterms (Zetterberg 1965). If a theory is empirically verified, the miniterms must be expressed in observational variables - strategic variables (Allardt 1970).

We may consider two further aspects of the concept of theory. Each theory is intended to explain one or more experienced phenomena. Thus, the theory determines how the phenomena shall be interpreted, that is, that a theory sets forth not only the relations postulated as existing between different concepts, but also the meaning or value of these concepts (cf Radnitzky 1968 b). Another aspect is to regard theories from the standpoint of the method used in setting them up (cf Rudner 1966). Simply stated, we may here speak of two different scientific traditions for gaining knowledge (cf Radnitzky 1968 a,b) - a humanistic and a naturalistic tradition.

By curriculum theories I will here on mean systematic relations between different concepts as to why the teaching shall have a certain content and why it shall be carried out in a certain way. Thus the curriculum tells what the teaching shall include and how it shall be carried out, a curriculum theory is the rational explanation of why. From this standpoint one way of surveying the literature is to start on a meta level. Herrick & Tyler (1950), Beauchamps (1961, 1968) and Johnson (1967) have brilliantly done this. Their surveys are conceptual analysis that bring out the components on which a curriculum theory should be based. Likewise, Maccia and coworkers (1963) have built a model based on concepts taken from information theory and system theory. But these works do not attempt to explain how curriculum planners "prefabricate" the concepts and how they are interrelated. Another way of approaching the problem is from the standpoint of theory building and thereby on an epistimological level. On an abstract level I will here allude to two groups of theories. One approach is through the values underlying curriculum decisions, which represents a more humanistic tradition, another is by way of actual information on how people behave and why, which represents a more naturalistic research tradition. I will call these approaches philosophically oriented theories and theories based on behavioral sciences, in order not to exclude other fundamental ways of approaching, but to indicate the existing traditions.

The philosophically oriented theories (cf Lundgren 1972, p. 31) are based on assumptions as to value and use deductions to arrive at a program. This line is represented by prescriptive normative theories (cf Dworkin 1959, Cronin 1961). The usual way of describing these theories is to describe the concrete types of curriculum they have led to (cf Sandven 1949, Strönnes 1954 and Harbo 1967). Another path is to seek out the basic theoretical principles they follow (cf Wynne 1964) or the purely philosophical currents they represent (cf Brameld 1965, p. 21). Since Dewey's time, a mass of philosophically oriented theories of this type has sprung up. Brameld's (1956, 1965) reconstructionist curriculum theory, Broudy's (1961) "realistic" theory and Phenix' (1964) science oriented theory are three examples of different types of theory presented during the past two decades (cf Björndal 1969).

We shall leave aside the assumptions of values these theories build on, and concentrate on the underlying principles for the deductions. The assumptions come from an analysis of the social and cultural environment of which education is a part, or from basic ideas on the structure and meaning of knowledge. From these assumptions, the theories are formed as logical manipulations of the given assumptions. The assumptions may be true or false, but the theory stands or falls with the process of deduction. But with very few exceptions in most works within this field the basic assumptions are never clearly given. Nielsen (1970) has sharply criticized most theories of this type exactly on this basis. "But assumptions that are to form the basis for pedagogic consequences, are hardly ever so well defined that any unambiguous conclusions can be drawn from them". (Nielsen 1970, p. 25).

Another basis for critically evaluating these theories is whether they are relevant for educational planning today, and their possible importance for changing the orientation of education. If we regard the curriculum as a part of the enculturation process of the society, they seem relatively difficult to imply. Education has changed meaning and its orientation is steered by political values.

This change can be described on two levels; a social (cf Coombs 1967) and an economical (Denison 1967, Blaug 1966). An increasing part of the resources of society are allocated to education. This, in turn, has led to a more conscious planning of the educational system as well as to demands for functional theories on which revisions and reforms can be based (cf Dahllöf 1971 b).

This change in the popular conception of education makes the philosophical oriented theories seem rather to be contributions to the debate on social and cultural problems than scientific theories. What is needed are analyses of the expression that political decisions find in different curriculum progrems, as well as empirical analyses of the demands now made on curriculum content (cf Dahllöf 1963). Such cirtical analyses must take up not only the process of deduction built on political evaluations. They must also analyze how different resources offer alternatives and how these alternatives can be measured against the evaluation. In turn, this necessitates information on how different resources limit the possible directions the teaching process may take.

The second group of curriculum theories are a mixed group built around principles for carrying out the teaching. Björndal (1969, p. 85) in a survey, calls them "rational theories" and points out that during the past two decades curricula have been deeply influenced by theories developed in neighbouring sciences. After the school reforms of the late 1950's (cf Goodlad 1964, 1966), this type of curriculum thinking has dominated the field (cf Passow & Leeper 1962, Heath 1964). As for more comprehensive theories or models, the work of Tyler (1950) and Taba (1952, 1962) have been of basic importance. These theories often originate in various psychological theories on processes of learning and cognition. A curriculum thus springing from this well cultivated garden must include both the basic psychological theories and a fund of knowledge making it possible to transplant them to the school yard. The basic question is whether this transformation is possible (cf MacDonald 1965). Naturally it is possible, as long as the teaching situation is not limited by time and includes only one teacher and one pupil. If this is not so, the recommendations must be made in relation to knowledge as to how teaching is formed when it involves more than one pupil and the time available for it is limited. Since teaching does not permit unlimited time and one-teacher - one-pupil relationship, this type of model must, if it is to be developed into educational theory, be extended with the help of a model over relations between factors that form the teaching process (cf Smith 1967).

The need for comprehensive and empirically based theories is also clearly felt by most researchers (cf Goodlad 1960, p. 196, Doshay & Beilin 1969, p. 276, Hawthorne 1971, Eisner 1971). We may also ask: what influences have different curriculum theories and theories on learning had on instruction in the classroom? Obviously they have been important but the answer given by Hoetker & Ahlbrand (1969) in their analysis of teaching during the half century gives a pessimistic view. One answer seems to be possible to base in the fact, that most theories with few exceptions are not empirical tested. Instead, they have been built on different hidden assumptions of what teaching is (cf Jackson 1966).

Educational research has a long empirical tradition for studies on the effects of different treatments (cf Campbell & Stanley 1963), and for analyses of individual differences and learning

ability (Gagné 1967). But these studies lack a theoretical base for how the treatments are to be formed and empirical methods for how they are to be described. ATI-research (cf Cronbach & Snow 1969, Bracht 1970, Gustafsson 1971) have from another point of departure raised the question of methods for analyzing the teaching process (cf Kallós 1975).

But to get satisfactory analyses we must take another theoretical approach. This is the hub of the matter, and there is where I want to fit in our general model and approach.

Classroom Discourse Analysis

The main problem does not lie in the description per se. Descriptions of teaching does not move us away from prescriptive models, if not the basic relations between theory and observation is explained (cf Gowin 1972, Scriven 1972). This basic problem concerns what purpose scientific theories are going to serve as well as what ideals of science we are aiming at.

We have a very strong empirical tradition in which teaching processes have been empirically studied. This research line has developed from different purposes and different needs. Very early the evaluative purpose has been basic (cf Medley & Mitzel 1963) and steering. This motive has been central and has also turned the practical implications early toward teacher education and training (cf Amidon & Hough 1967, Flanders 1970, Smith 1971, Gage 1972, Dunkin & Biddle 1973). The development of different systems for analysis has mainly been nourished from existing research lines within psychology and social psychology (cf Thelen 1951, Bellack 1967, Westbury & Bellack 1972, Dunkin & Biddle 1973). Other researchers have looked upon classroom discourse analysis as instruments to bridge the gap between philosophical and psychological theories and educational practice (cf Smith 1967, Smith & Meux 1962).

Surveys of research and systems for analysis are many (cf Huthall 1970, Simon & Boyer 1970, Westbury & Bellack 1972, Gage 1972, Lundgren 1972, McNaughton 1972, Bellack 1973, Dunkin & Biddle 1973).

The theoretical base for the systems of analysis is the central problem (cf Bellack 1962). One characteristic of this research line is that most studies have been based in simple and pure positivistic (cf Kolakowski 1970) notions about the relation between theory and observation. Research problems have turned over to be technical problems for observation. In order to understand why, certain systems of analysis have been built around certain concepts, one is often forced to track influences back to academical traditions within various research groups. I will not argue for an opposite position in the relation between theory and observation, in which "there is no way in which one can legitimately talk of the disproof of one crucial theory by observations described in the language of another". (Scriven 1972, p. 118). But I will accentuate in the discussion this complex problem, which obviously implicates that every researcher has to explicitly describe the theoretical assumptions that a priori lie before any observation.

This pinpointing of the relation between theory and observation means as a consequence that an analytical discussion of research lines must concentrate on basic theoretical concepts. I am here forced to concentrate the discussion and will therefore just ring in two basic different research lines.

On one hand we have an overwhelming mass of studies with observation systems based on psychological and social psychological concepts and thereby theories. Ashner & Gallagher's (1962) study illustrates a psychologically oriented study. The approach used by the Stanford Group (Gage 1972, Gage et al 1972) represent a basic reductionistic ideal that principally can be classified into this group. We have two research lines based on social psychological theorizing. On one hand we have interaction analysis, which emanate from the Chicago school of thought and has been successively developed by researchers as Anderson (1939), Withall (1949), Flanders (1965, 1970) and Amidon (Amidon & Hough 1967, Amidon & Hunter 1967, Amidon 1970). On the other hand there is one line based on dyadic analysis and role theory (Adams & Biddle 1970, Good & Brophy 1969, Power 1971).

The second main group has another theoretical base. This research line is represented by two groups of researchers; Smith & Meux (1962) and Bellack et al (1966). Smith & Meux have another per-

spective on the role of the observation systems. Instead of building the system from a priori assumptions taken over from other sciences, they try to build up a theoretical frame, from which leads a more structuralized way of describing teaching. The main task is to identify acts and operations which give a logical meaning to teaching. Teaching is looked upon as a social phenomenon (cf Westbury 1972) - a system of acts with an agent, a goal, a situation and factors that to some extent control the situation. With these concepts as niniterms a model is built which concentrates on describing how the teaching structure is developed as a consequence of the acts of the agent.

Bellack et al (1966) have a similar basic idea, but are starting from the concept of game (Wittgenstein 1958). The structure of the teaching is here described in terms of rules. In both these ideas I will interpret the impetus of a structuralistic thinking in which the teaching is lokked upon as a series of transformations (cf Piaget 1968).

A further development and integration of these works points also in a direction, which is approaching on a cursory level the ideas developed within social antropoly (cf LeviStrauss 1971). Very close to this is a more linguistic approach, which has been touched upon by Biddle & Adams 1970 (cf also Adams 1972, Bichel 1972, McNaughton 1972).

These two basic research lines are from my point of view important to keep separate, and I will later on return to some further distinctions of consequence for our model.

During the sixties studies in classroom teaching process increased very rapidly. In some respects the expectations were very optimistic (cf Gage 1972). The main relations to be established were between on one hand presage variables and the process and on the other hand process variables and outcome (cf Dunkin & Biddle 1973).

The descriptive comparative studies over time and school systems (cf Hoetker & Ahlbrand 1969, Bellack 1973) seem to have given birth to the most interesting questions. The summaries made over relations between groups of variables are more frustrating (cf Rosenshine 1970,

Rosenshine & Furst 1971, Rosenshine 1972, Gage 1972, Dunkin & Biddle 1973). In lack of common basic concepts the studies are difficult to compare, and when possible to compare, the results show few consistent patterns. The recommendations for solving this dilemma are many (cf Kallos 1933). Gage (1963) did very early argue for higher conceptualization of the patterns of thinking. But in summing up the consequences a pessimistic tone (Gage 1972) appears. Flanders (1969) points on the fact that most studies hitherto are made as doctoral studies and that long-range projects exist. The theoretical discussion has mostly been concentrated around the relations between the concept of teaching and the concept of learning. A reductionistic view of teaching has been dominating. Smith (1961, 1962, 1963, 1967) points on the effects of this perspective in which the social phenomena of teaching is reduced to a behavioristic perspective. Komisar (1968) argues from a logical standpoint that teaching always is aiming towards learning. Mc Clellan (1972) has pointed on the relevance of the term ends and means. Westbury (1972) argues brilliantly for seeing this discussion on two levels. On one level the teaching process must be looked upon as a social phenomenon, which must be studied in its own right. Lundgren (1972) separates analytically between two types of processes - external processes and internal processes that means that the pupil in one respect must be looked upon as a part of a whole, and in another respect as a whole, possible to analyze into different processes. In its turn this moves the question of reduction away from the scene. Two models for explanations must be built that are complementary, but are not built with the same miniterms. A theory based on learning process gives no base for explaining how the student through existing frames, goals and rules is exposed for learning.

Another critical discussion has centered around the designs and the statistical methodology. Travers (1972) argues for more experimental studies. Jackson (1966) in his theoretical distinction between preactive and interactive phases gives arguments that are contrary. On the same hand these distinctions and the further development mirror quite another perspective in which the understanding of the process is more underlined than a mere deterministic explanation. Rosenshine & Furst (1971) give four suggestions for methodological improvement.

In some respects a research tradition has been established that from my point of view seems to move us away from the basic theoretical questions and turn us into a methodological discussion in which the phenomena of study is lost. The basic questions are on quite another level. Just to take one example: are the categories used possible to quantify? Is the verbal utterance for person A in situation 1 the same as utterance for person B in situation 1 or situation 2 or for the same person the moment after the first utterance? In relation to criteries for judging cognitive similarity, they are not the same (cf Naess 1964).

To a great extent the internal critizism of research and suggestions for future research mirror clearest the basic ideas about the phenomena under study and the rules for research. In the sense Kuhn (1962) uses the concept paradigm we can here identify very simply paradigms. The research follows certain paradigms and the researchers thereby have, what Wittgenstein calls aspectblindness. Gage (1972) asks just this question; if not the development within this field is following a hidden basic idea or a scientific paradigm (cf Kuhn 1962) that are giving a false perspective of the phenomena. But he stops here and interprets the notion of scientific paradigm in the sense of an internal research paradigms. The recommendation he gives is, as a consequence of this, to more strictly follow existing paradigms. Instead of recommending analyses of basic principles and basic lines of thought in order to discover the weak points and make a break through possible, he refers to the way the natural sciences have gone into deeper and finer elements. In fact, some natural sciences are going another way back and up (cf Waddington 1971) in order to create the basic systems and models. The present situation has different causes, that are difficult to map out. We have also simplified the discussion in order to just pinpoint the critical and strategical problems. I will just allude to three characteristica within existing research.

On the first hand the dominance of American research has established certain normative elements. Elements that never have been pointed out by the researchers. This has led to the fact that systems for analysis an seldom based on any explicit given model and thereby "does not stem from any intrinsic qualities of behavior, but rather is arrived from the moral order of American culture". (Walker 1972, p. 41).

On the second hand most studies with few exceptions (cf Jackson 1966, Smith & Geoffrey 1968, Smith & Meux 1962, Bellack 1973), have been pure emperistic. This empiricism has turned out in two ways. On one hand through the uncomplicated ideas about the relations between theory and observation. On the other hand the normative role that has been given to psychology and social psychology. The problems of inquiry have often been derived from psychological and social psychological theories and thus the concepts used have only indirectly a pedagogical relevance.

The third point for discussion is linked to the two former and can be labeled - the implicit explanation. Most researchers have started with an implicit explanation derived from the didactical tradition and hidden in the concepts used. Changes in systems for analysis seem often to have been done in relation to implicit criterias, in relation to what the researchers think teaching is or is not. These three simply stated characteristics an forming the paradigm.

The research situation seems to need a step back and more careful analyses of what has been done, and why, and to what purpose, than to new recommendations for another correlational fishing trip. To some extent the existing trends in the discussion can be described with an analogy taken from Koestler (1967). "The situation is similar to building a cathedral out of a mass of bricks and asking for better cut bricks than for a blue-print".

Chapter 2. The outlines of a theory

The theoretical model is on a high level simple. Dahllöf (1967 a, 1971) has stated the basic ideas (cf Dahllöf & Lundgren 1970, Dahllöf, Lundgren & Siöö 1971). We show its three components in a paradigm:

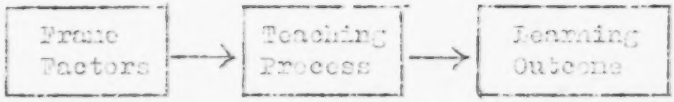

Fig. 1. The basic paradigm

This paradigm expresses in a general way the relations which probably have guided most educational planners. The difference between this model and others lies naturally in the definition of the concepts and the assumed relations (cf Lundgren 1972).

Our basic assumptions are given in the notions on the teaching process. The teaching process is a steered process. A process made of transformations having a position in time and a prolongation in time. The key concepts are transformation, time and steering. A structured activity has always the form of a transformation system. These transformations are regulated by rules. These rules in their turn are consequences of two main factors. The frames given for the situation and the goals for the process. With frames I mean factors that limit the process - the organization and size of the student group, physical locations etc. One main factor that it is necessary to discuss separately is the time frame. The goals of the teaching steers the direction of the process and can in some aspects be described as frames (Lundgren 1972, cf Kallos 1973) even if this seems analytically and pedagogically unwise (cf Dahllöf 1971 b).

From these basic distinctions we can develop our model in the following way:

A. The teaching process is a system of transformations following a set of rules.
B. These rules are consequences of the organizational frames and the time frame.
C. The meaning of the actions which define the transformations are steered by the intention of the participants and thereby by the goals.

This means that the relation between frames and process cannot be seen in a pure deterministic way. The frames steer to some extent the rules and make a process possible to exist or not exist, but from a set of frames we can just predict the rules, not the actual process. In using the analogy with a game we can see the frames as give birth to some general rules. How the actual game develops within these rules is another question. In answering that question we have to analyze the meaning of the game, what purpose the players have. The other steering aspect is therefore the goal of the teaching process.

In applying this perspective we come very close to an epistemological idea within linguistic (de Saussure 1916) and social anthropology (Levi-Strauss 1962). We can here talk about two levels according to de Saussure, "language" and "parole". Language is the level on which we describe the rules. To follow these rules does not imply that I am a "good player". On the "parole" level we can talk about more meaningful or effective ways of using the rules.

In seeing the relations between teaching process and learning outcome we have to analyze differences on the "parole" level. That means, that we have both to lokk upon the relation between parts of the process, but also on the process as a whole. How the different transformations correspond to goals and to the intention of the actors.

To analyze why Bobby Fischer, just to take a concrete illustration, is a more effective chess player than Spasky is not a question of looking on the number of different moves, it is more a question of how a strategy is followed, how different parts are developed and the purposes and intentions with each move.

In seeing the relation between teaching process and outcome on this level we have also some basic truistic assumptions about learning, which means that we assume that learning takes time and the person that is learning must be exposed to some information.

This discussion does not give a total formalized theory, but a set of concepts and interrelations between concepts that can be analyzed on a empirical level.

To simplify I concretizise the discussion in fig. 2.

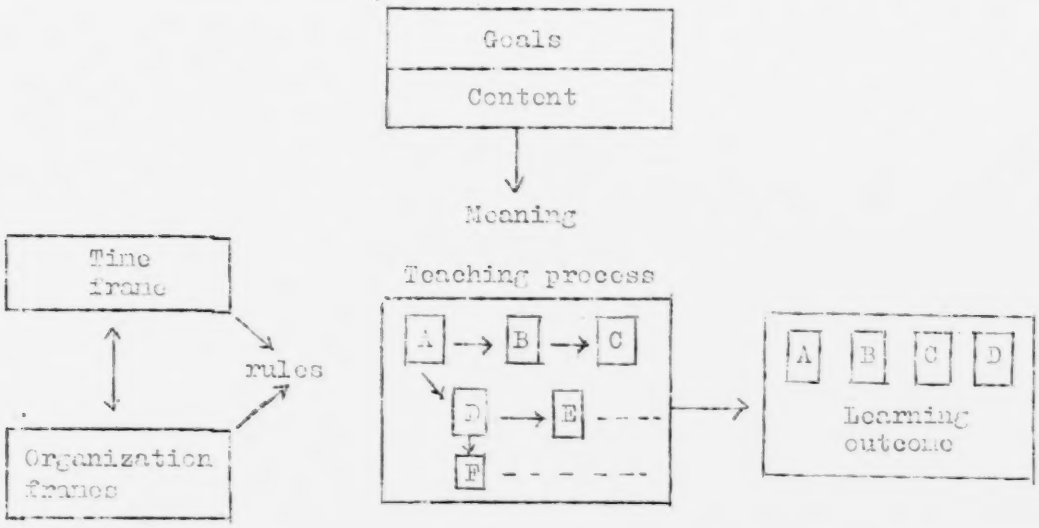

Fig. 2. Paradigm over relation between rules and meaning in relation to frame factors and learning outcome.

The actors of the process have been indicated within the paradigm. The problem with representing theoretical ideas in paradigms is obviously shown in comparing the discussion and its implications with fig. 2.

The tested model

The next step is to find the strategical variables and to concretizise the model in order to make it possible for empirical verifications.

In the coming discussion there will be some inconsistent parts. This inconsistence is on one level due to the problem of selecting strategic variables in a complex system. A more obvious reason on another more practical level is the research process itself. The theoretical ideas here presented were to some extent before the empirical studies, but have to some extent been developed by the process. This will be clearly demonstrated in the following.

The first step in selecting strategical variables will be in the frame factor group. We will here use one varable - the composition of the teaching group. The reason why goes back to the starting of our research.

The basic model was developed as a consequence of a critical overview of research on ability grouping made by Dahllöf (1967, a, 1971). He found that research (cf Heathers 1969) had followed a very simply paradigm, in which the composition of the class had been the independent variable and simply tests of knowledge the dependent variable. No content validity studies in relation to the actual teaching process were done. In having access to data of the time for different curriculum units, Dahllöf could reanalyze one earlier study (Svensson 1962). The results show a very marked pattern and great differences between various groups of pupils. The interpretation of this study was turned over to a discussion of the relation between frames and processes (Dahllöf 1971 a,b).

In order to further develop this basic model we (Dahllöf & Lundgren 1970) decided to concentrate on the composition of the class in relation to ability as the first frame factor.

On the process side we found it necessary according to our basic theory to both follow the process for a long time on a macro level, as well as to follow the teaching process in more detail in the single classroom.

The evaluations turned out in the direction of combining a study of the teaching process on a macro level (extensive data) and on a micro level (intensive data). On the micro level we tried to analyze the process in the first hand in relation to the basic rules the teaching followed. In this respect we tried to apply the system for analysis developed by Bellack et al (1966). In the second hand we also tried to analyze the meaning of the single parts of interaction by use of content classification and by classification systems developed by Amidon & Hunter (1967) and Bales (1950). On the macro level we left the pure rule identifying idea and tried to follow the process from the decisions taken by the teachers in relation to goals and frames, as well as how the experiences of the students changed as a consequence of these decisions and their goals.

On a data level we used in the extensive study a panel with four questionnaires during one school year (October, December, March and May) to the teachers in English, Mathematics, History, Swedish Literature and Civics. The teacher were asked what they planned to do lesson for lesson up to the time for the next questionnaire. The actual teaching, that had been carried out was also described lesson for lesson for the time for the questionnaire before. This design made it possible to compare planned and actual teaching. For students a panel of three questionnaires was used (October, December and May). On the intensive level we sampled eight classes during one semester in the teaching of mathematic . An observer was used and the lessons were sampled out and tape-recorded.

The study was carried out in the high school in grade 11. The extensive study included 46 classes and the intensive study 57 lessons in eight classes. The results were measured with standardized knowledge tests.

In fig. 3 I have tried to schematize the design in relation to model and type of data.

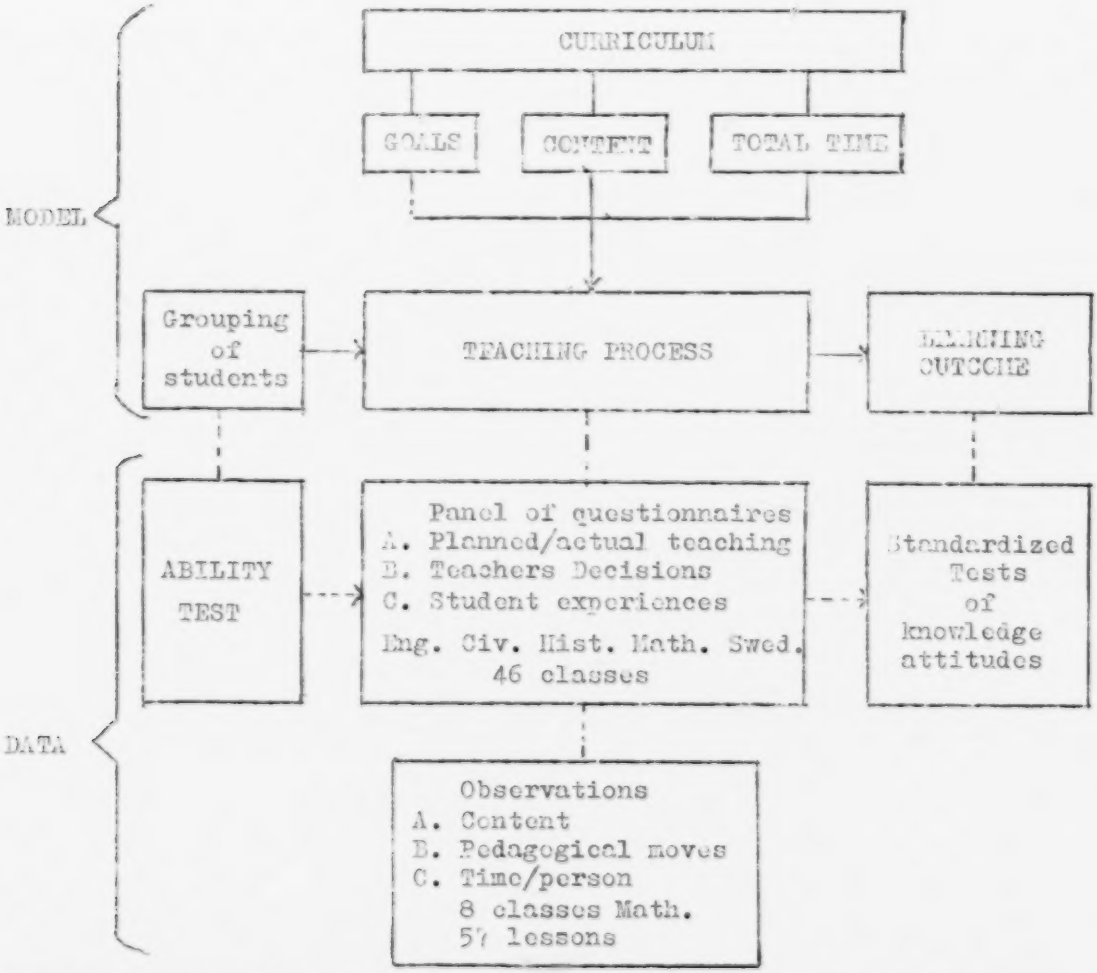

Fig. 3. A paradigm on the tested model and types of data.

The next step is how to establish the relations between the organizational frames (the class composition according to student ability) and different measures of the teaching process.

In order to do that, we have started with cutting out one dimension in looking upon the rules. We will do that from a pragmatical aspect, the different pedagogical roles the students have in the teaching process. With pedagogical role I mean the specific types of action that each student in a class is involved in.

a) The roles are defined in relation to the teachers' and the students' perception of the goals and to the frames that limit the process.

b) These limits mean that the students are interacting in different ways, but the more the frames limit the process, the more different groups of pupils will be established that interact in a similar way.

The concept of the steering group

In order to test our model we have to identify the pedagogical roles. As we have no empirical knowledge of their existence, we have to deduce som hypothesis from our theory.

Once again, for explaining why we have deduced certain hypotheses we have to go back to the earlier study that was interpreted by Dahllöf (1971 a). In the reanalyzing of research on ability grouping Dahllöf (1967 a, 1971 a) found a similarity in the result pattern. The time disposed on elementary curriculum units seemed to covariate with the absolute value of the student between percentile 10-25 in relation to general ability in each class.

This was interpreted as the teacher used this group of students as a criterion group. In relation to elementary units in the curriculum these students formed one pedagogical group.

This can be theoretically interpreted in two ways. On one hand we can see the forming of this group as an effect of the actual frames and goals. This means that when studying different school systems, the actual steering group will change. On the other hand we can interpret this as a fixed group. This means that the

teacher always relates the goal level to the frames and interprets his educational role in a way that he always will steer the process after the group at about percentile 10-25.

These to interpretations make two extremes. The possible explanation should be between. The actual steering group is varied, but according to the teacher's interpretation of his role there are limits for this varying. This means in its turn that we can set up a hypothesis in which we will test if the process is steered by the steering group (P_s) percentile 10-25.

This value is looked upon as the best estimate. It does not mean that in the single class this is the operational definition of the steering group, but when comparing various classes, this is the best estimate.

In fig. 4 we show a simple paradigm of the relation expended in this hypothesis.

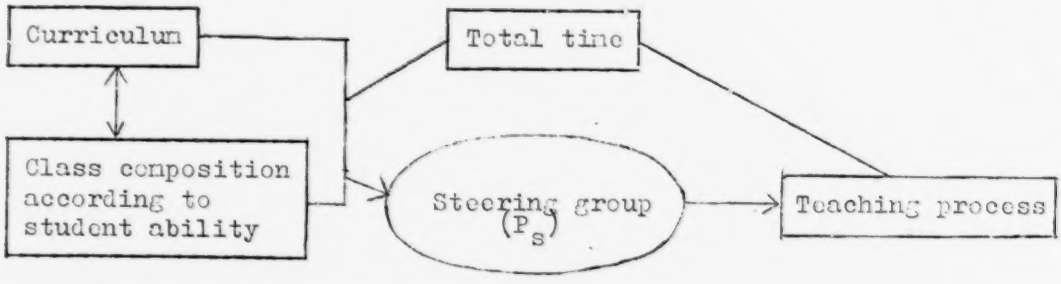

Fig. 4. Paradigm over relations between frame factors, goals, steering group and teaching process.

The next step will be to present the empirical data in order to verify the basic relation here assumed.

Chapter 3. The analysis of extensive data

The extensive analysis had two purposes: one, to test and find a methodology for analyzing the teaching process from a comprehensive point of view; the other, to test our theoretical model.

The distinctive marks of the Swedish school system and the curriculum under study will not be discussed here (cf Lundgren p. 85-95). These features are obviously of importance for design, analysis and interpretation, but as much as possible I will try to discuss the analysis on a more general level. Descriptions of data and discussion of reliabilities, validities and response rates is also left out and I refer to the final report.

Methodology

The design we used - data from questionnaires collected according to a panel method - caused a series of problems that were difficult to foresee during the early planning phases.

The use of panel data causes statistical problems in both description and analysis (cf Coleman 1964). The first is the question of which parameters are determed in the descriptions.

In an educational system the populations undergo successive changes. The individuals in the classes being studied do not remain constant. Teachers become ill and are replaced by substitute teachers having a different education, experience and background. Pupils leave school or move another district. Both the number of individuals in the classes studied and the structure of the classes change constantly. In this situation it is almost impossible to speak of describing a "population". Instead we have preferred to see this problem as a question of educational systems. In order to draw conclusions from a study of this type that can be useful for the teaching in another system, the thing to look for is rather similarities in the prevailing conditions and in the type of changes that are affecting the individuals concerned.

We have therefore tried to avoid discussing parameters or representativity for the individuals being studied, by not seeing them

as parts of a plausible population. Instead we have tried, in our descriptions, to find the strategic variables in the conditions for which the educational system was created, what principles the curricula follow, how they are constructed and what qualities the teachers and pupils have. We assumed that those who answered our four questionnaires were representative for the group being educated in that school at that particular time.

Another problem was to analyze the changes that occurred with the passing of time. The attitudinal changes we found from one occasion to another, may be the result of actual changes of attitude, but also of short comings in the instruments. We have not made any reliability studies of the individual change too deeply, and concentrated instead on what was systematic in these changes and on whether the changes have theoretical and conceptual validity. The result of each individual question has therefore been interpreted with caution.

We have a mass of information on human behavior to work with. We have tried mainly to see the trends and patterns in it, partly in order to discover whether the primary relations on which our model is built will hold, and partly in order to lead the more detailed intensive analyses. Two ways of analyzing this data are open to us. One is to do detailed statistical analyses of the various groups of variables and individuals variables; at each step of the analysis, other variables would be controlled. Such a detailed analysis must then correspond to a precise theoretical model and to well-tested instruments. In our case, the model is more of a rough sketch, and there are no earlier methods for analyzing the teaching process to fall back on. To analyze this information in detail would not be of much use. We therefore decided to try another way, of making rather rough analyses of trends to trace the direction of the relations and the results of different variables, in order to test which are strategic.

A first test of the steering group hypothesis

To test our model we need a reasonable variation among the variables included in the model. The curriculum must be the same for all classes but the organizational frames should vary. We worked with the academic-lines high school, which have a very narrow

variation in the composition of the classes. When the students were channeled into different study lines, the size of the material available to us decreased. The subjects have different structures, which causes variation in describing the content and in the limits set by this description. The textbooks have also varied. If the material we obtained is compared to the theoretical model to see if we can use the material for testing, the prognosis is not too good. If the relations between frame factors and teaching process appear, the model would have high validity.

We are working with a series of different independent variables, where the material is not sufficient to bring out the separate constellations of variables. In spite of this, the statistical work we have done shows that the model can be further developed theoretically, and we interpret this to mean that it has a certain strength. It is possible to bring out the principal relationships.

In the classes in which P_s reaches a high level, and in the classes in which it is on a low level, the textbook seems to have a greater steering function for the teaching process than in classes on a middle level. In these two cases, the planned teaching also agrees to a greater extent with the actual teaching. This happens when we define the teaching process as the time spent on units. If we seek an explanation in the teacher's decisions, the similarity between P_s-high and P_s-low can be interpreted as follows. Each unit can subjectively be split into elementary or basic parts, and advanced parts. By subjectively we mean that this split is not expressly stated in the curriculum, but that the teachers understand that such a split actually exists, and even if they classify elementary and advanced parts somewhat differently, they see it as relevant for them. In addition the curriculum states, in the section on methods, that the teacher shall see to it that the whole class masters a "core" of the content. When the teaching process is seen as curriculum units taking a certain amount of time, the time spent on each curriculum unit is about the same for classes having a P_s group at either a high or a low level. But within these units the time on elementary and advance parts of units varies. Classes having a P_s at a low level are assumed to spend more of their time on the elementary parts. The thing that confirms this assumption is that the teacher feels that the

entire class must master the elementary parts, while it is enough if a certain group masters the advanced parts. In other classes, other decisions are necessary. Teachers of classes having a P_s at a low level may at an early stage of the planning decide to leave out certain parts of the content and to take up other parts in less detail. These early and general decisions make it possible for the teaching process to follow the teacher's planning with a minimum of hitches.

In the other classes, the decisions will come successively. Here, the teacher makes a series of decisions which are different on different parts of the course and occur at different times. The teacher makes three types of decisions. Firstly, he may lower the goal for certain parts of the course. Secondly, he may exclude certain parts of the content. Thirdly, he may let a certain group of pupils lag behind. The first two types of decisions are thus linked to what the teacher considers to be advanced parts. Through lack of time, the content steers the teaching process and the textbook becomes captain.

This is a very general summary of the results we have presented and must not be seen as anything else. Each statement we have made refers to the discussion in the final report (Lundgren 1972). Our explanation rests on a very dynamic model, and each relation is anchored in the original model. We may summarize this in the following paradigm.

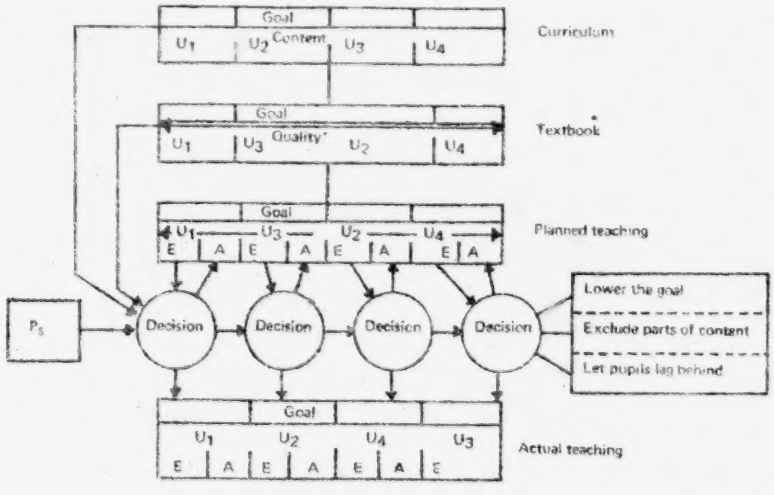

Fig. 5. Paradigm of the principal relations between the steering group's steering of the teaching and the teacher's decisions on planned and actual instruction.

The teaching methods very little. The dominating teaching pattern is the traditional classroom instruction. But within subjects it varies. In table 1 is given the total relative amount of time spent on traditional classroom instruction according to the teachers' estimation.

Table 1. The relative amount of time used in the different subjects for traditional class instruction. In percent.

Eng.	Hist.	Math.	Civics	Sw.	Total
81	63	86	59	38	73

This can be interpreted in two ways. Firstly, it may mean that the method is adapted only to a certain group of pupils (P_s), and thus varies very little. Secondly, it may mean that the teacher chooses the method with which he is most familiar; he does this because he does not have the time to adapt the instruction individually over and above what is possible in the verbal instruction in the classroom situation.

Individual instruction means, strictly speaking, a variation of the teaching methods, and that the teacher has time to spend on each pupil. If time is limited in relation to content and teaching aids are few, the teacher has no time to use any other method than classroom instruction; he is thus forced to use the verbal instruction for adapting the teaching to the specific pupils. It follows that this steering of the content ought to mean that the less time there is available, the less possibility the teacher has of adapting the verbal instruction to each individual pupil.

A certain differentiation will then occur in the way the teacher treats different pupils or groups of pupils in the class. We have shown that, as time goes on, the content governs the instruction more and more. The closer the class comes to the end of the school year, the more the teacher is forced to let the content steer the instruction. This steering of the teaching by the content means that the pupils experience the teaching as different from what it was at the beginning of the term. Their interest in it dies somewhat down. Interestingly enough, we can see a certain trend in

their conception of the way they are being treated. The lack of time causes the teacher to differentiate the instruction he is giving the class. Some pupils are allowed to take part more often, others less often. This relation appears if we regard the pupils' reports on how often they are allowed to take part in classroom instruction, as being an effect of the teacher's questions. On the other hand, there is not the same difference as to their own initiated participation.

Chapter 4. The analysis of intensive data

Eight classes were followed during one semester in the teaching of Mathematics. The lessons were sampled out. Neither the teacher nor the students knew the observer was coming. In all 57 lessons were observed and tape-recorded. Every lesson was mimeographed.

The analytical unit used was the single verbal utterance (in some instances single non-verbal messages were coded). This analytical unit was defined with small modifications in the same way as the pedagogical move in the Bellack system (Bellack et al 1966).

The observer seemed to have little influence on the teaching according to the interviews with the teachers. There are two reasons for this. Firstly, most classes in Göteborg have continued visits for student teachers because a Teachers College is situated in the city. Secondly, the observer was young and probably merged early into the class.

The classifications of the classroom communication

The analytical unit is the pedagogical move. We have used the definition with small modifications, given by Bellack et al (1966). To the four basic moves we have added a fifth move, HEP, which is coded when individual help is given and just one student is involved.

The move is the smallest unit. In the extensive investigation, we classified the content of each lesson. We then divided each lesson into themes. A theme is a longer sequence of moves with a common content. The themes are to some extent comparable to the division into "teaching strategies" made by Smith & Meux (1962 cf Chapt. 4), but they are classified mainly on the basis of content.

The themes are primarily developed around common parts of the content. They may be seen as a micro-unit of a teaching unit - a certain content that is common for one sequence of the communication. The term "strategy" means that the development of this content follows a certain logic or pattern. By the term "theme" we wish to distinguish the classification on the content from

the pattern of pedagogical moves within each theme. In analysing the themes we look at which patterns or strategies are followed.

We divided each lesson into themes. The content in each theme is not classified from the beginning, but described verbally, e.g. filling in attendance cards, individual work with exercise no 86 etc. From these descriptions we made a classification in seven main themes.

Not subject-relevant
1. Themes, not subject-relevant and not relevant for the tasks of the teacher (NOS)
2. Classroom management (CLM)

Subject-relevant
3. Going through theory (TEO)
4. Going through type examples (TYP)
5. Working with exercises (EXP)
6. Examination and control of homework or written test (CON)
7. Going through and preparation of homework or written test (GIV)

The themes are developed by longer sequences of moves (cf also Flanders 1965, p. 22, Gallagher 1970 a). Certain problems occur when we distribute the main themes into subject-relevant or not subject-relevant. Individual moves within a subject-relevant theme may be not subject-relevant, for instance, when a pupil asks the teacher for permission to turn on the light. In this case, the move is not regarded as an individual theme. In order to get a check on the relevance of the individual moves to the subject of mathematics, we have classified each move as subject-relevant or not.

The above example (permission to turn on light) may in some cases cause a longer sequence of verbal moves to appear that does not belong to the classified theme. Therefore we have divided each theme into three types:

1. Whole themes (WOT)
2. Interrupted themes (INT)
3. Interrupting themes (ITT)

Interrupted themes occur when the class is working on a certain content and something happens that interrupt this work. The interruption is only temporary and the theme is resumed later on. We

classify this as an interrupted theme with a theme inserted. A concrete example: The class is working with a type-example. One pupil arrives late, the teacher talks with him, whereupon the work is resumed. Classified, this would mean theme TYP of type INT followed by main theme CLM of type INT, then main theme TYP of type INT continues.

The classification into themes constitutes a comprehensive classification of the communication as to content. As often as possible we have also classified the individual theme, when it is subject-relevant, in reference to the textbook. The themes form a link between the classification of the teaching process in the extensive investigation and the analysis of the verbal communication in each class in the intensive investigation.

We have three basic concepts in analyzing the rules of the teaching:

a) the pedagogical moves;
b) chains of moves for one message. Pedagogical cycles;
c) themes;

Every move has been classified in the following way:

1. Class. Observation and number on move.
2. Theme.
3. Sender.
4. Receiver.
5. Verbal/not verbal move.
6. Called for.
7. Type of move (STR, SOL, RES, REA and REP).
8. Subject-relevant/not subject-relevant.
9. Logical and rating.

Logical is divided into:

	Analytic	Empirical	Evaluative process
Treating information	Interpreting (INT)	Explaining (XPL)	Justifying (JUS)
Giving information	Defining (DEF)	Fact stating (FAC)	Opining (OPN)

Rating is divided into:

	Positively toned	
Positive (POS)	Admitting (ADM)	Repeating (RPT)
	Negatively toned	
Qualifying (QAL)	Not admitting (NAD)	Negative (NEG)

Positive/Negative (PON)

Admitting/Not admitting (AGN)

10. Extra-logical process (PRF, DIR)
11. VICS.
12. Activity.
13. Bales' category system.
14. Duration of the move in seconds.
15. Time between moves in seconds.

Fig. 6. Summarises the different classifications in a sketch, showing the relations between the systems.

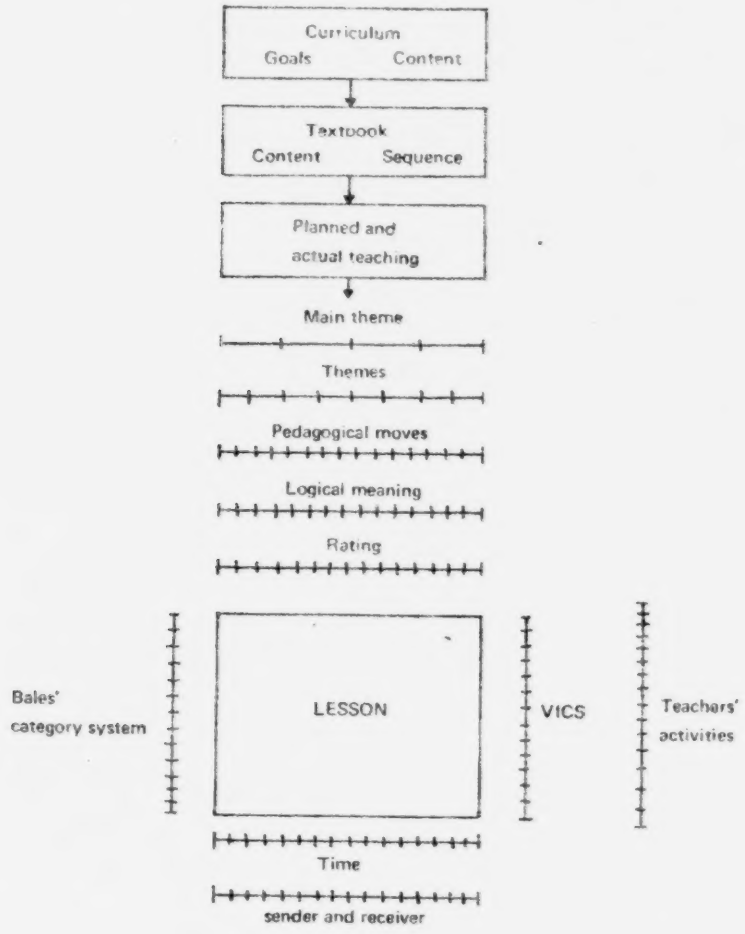

Fig. 6. A sketch of the systems of classifications and the relations between them.

We will not here discuss the reliability of coding (cf Lundgren 1972, p. 247-255) but mention that they in comparison to other studies have about the same values.

A second test of the steering group hypothesis

The operational definition of the "steering group" is the pupils in percentile 10-25 as to ability. Again I will point out, referring to the earlier discussion, that this is an estimate when comparing different classes.

There is a marked variation in the number of moves per lesson in the eight classes. We shall look at how this variation changes in accordance with the variation in four values for the class. Firstly, in the whole class as to ability; secondly, in the average value for the pupils in the 1st quartile; thirdly, in average value for the pupils in percentile 10-25; and fourthly, for the standard deviation.

Table 2. Correlations (Spearman's rank correlation) between number of moves per lesson and the average value of the class, the average value for pupils in the 4th quartile and the average value for pupils in percentile 10-25 as to ability. (N = 8).

	Average value	Average value 1st quartile	Average value Percentile 10-25	SD
r_s	.31	.81*	.88*	-.76*
range	10.52	11.00	13.83	8.07

From now on we shall mark significant values with an asterisk. The level of significance is 5 %.

The estimate used seems to some extent to be wise. But the difference between the 1st quartile and the 10-25 percentile is small. Anyhow, this table shows a strong evidence in favour of verifying the hypothesis of the steering group.

In the next step we have within each theme, within each class, counted the relative number of each category classified and correlated this with the absolute level of the steering group.

Before we present and interpret these relations, we shall look at how many significant correlations there were and what they mean. For the correlations that have been obtained for the different main themes we see that they are not distributed at random. 16 % of the correlations that were calculated for different categories within themes were significant. Of all correlations for the total classes, 28 % were significant on the 5% level. The other correlations, even if not significant, are high, and we can see a fairly consistent pattern when comparing the various systems used. In order to get an over-all picture, we sum up these results in two columns. On

the right we show the positive correlations, i.e. behaviors that increase with the P_g value, and on the left the negative correlations. The solid lines indicate significant correlations.

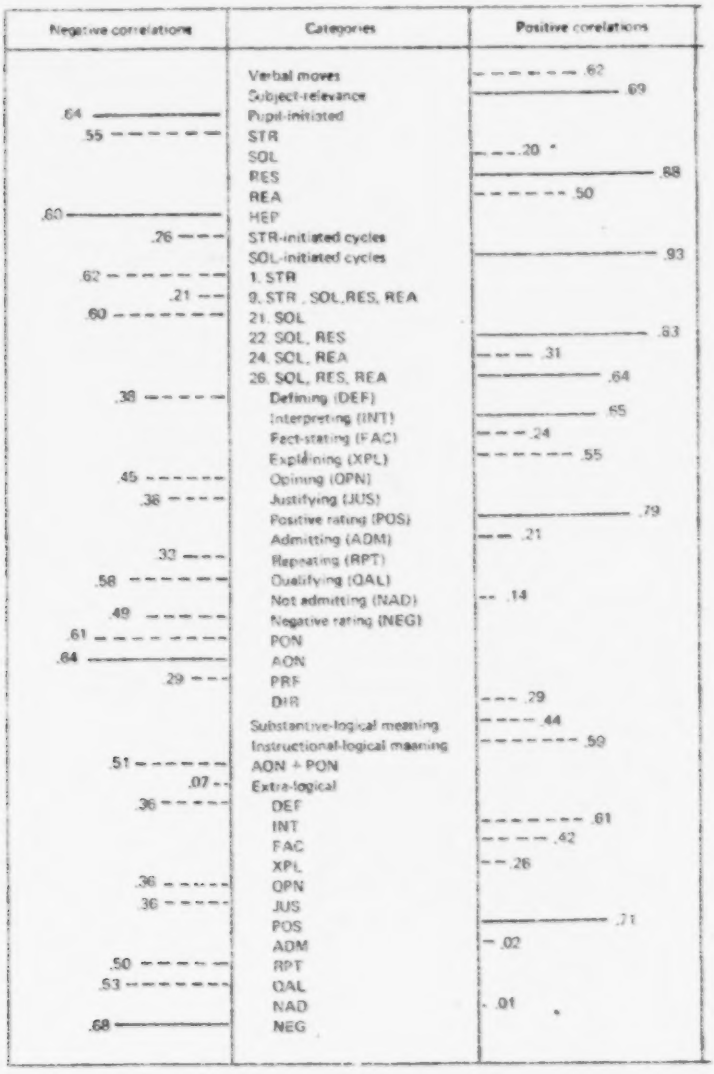

Fig. 7. Correlations between the steering group's ability level and verbal behavior. Cognitive dimension.

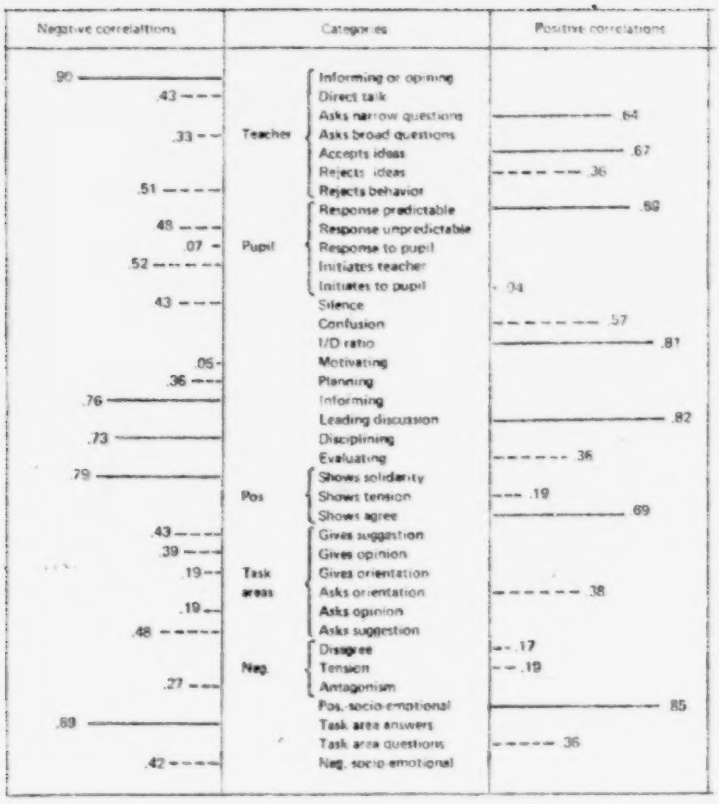

Fig. 8. Correlations between the steering group's ability level and verbal behavior. Affective dimension.

It is apparent that as the value for the steering group strengthen the rules described with the Bellack system and the teaching pattern becomes predictable. The teacher's role becomes more that of a discussion leader than that of a lecturer. The communication pattern in the classroom seems to become more fluid - the recitation pattern increases. The student gets the role of responder - his reactions decrease and the teaching is less often interrupted. The climate in the class becomes more positive and the teaching style more indirect.

In interpreting these results in relation to the basic theory we are to some extent in trouble. This illustrates our earlier discussion about the research process and the development of a theory. We have obviously not the same perspective in empirically describing the process as used in the theoretical discussion. Anyhow,

there are analytical points for comparison. And the interpretation here given follows very well the basic theoretical thinking even if on some parts suspicions can be raised. In the next step of the analysis we will anyhow strengthen our findings and thereby verify significant parts of the theory.

The role of the steering group

We have identified the pupils in percentile 10-25, as to intellectual ability, as the steering group. What role do they play in the communication? From the standpoint of the theoretical model we have set up, this role is especially prominent in the transition from one unit to the next. We cannot divide the communication into phases, since we are working within the time-frame for one unit. However, we should be able to proceed from the fact that, in taking up different parts of this unit, the teacher uses the steering group as a criterion. To a certain extent, this has been confirmed by the preceeding analyses. The next question is, whether the steering group differs from other pupils in frequency of participation, and what role P_s plays in the communication. Table 3 shows for each class the average value of frequency for these pupils versus the class as a whole. In this comparison, the pupils constituting the steering group are included in the class. We therefore minimize the differences.

There are no differences for senders. In half of the classes, the pupils in the steering group have on an average more moves than the class as a whole, and in the rest of them the pupils in the steering group have fewer moves than the class itself. For receivers, however, there is a difference, even though it is small. In six classes, the pupils in the steering group are more often receivers than the class on the average, and in two classes we get the opposite proportions.

Table 3.

Average value of number of moves for the pupils in the steering group and for the class as a whole.

Class	Sender		Receiver	
	P_s	Class	P_s	Class
1	1.7	3.4	7.7	6.9
2	8.3	15.5	12.8	23.9
4	32.0	27.2	42.0	35.7
5	10.0	30.4	12.0	36.2
6	25.8	22.0	35.0	29.7
7	7.3	6.9	13.0	12.2
8	15.5	10.6	18.0	15.1
9	10.3	12.1	18.3	14.7

These two classes have the ranks 1 and 3 for the value for the steering group. Totally, the steering group has a higher number of moves as receivers than the other pupils. It is above all as receivers that the steering group differs from the rest of the class. Table 4 shows the differences in pedagogical moves between the steering group and the whole class. Here we have used a Chi^2 and used the distribution for the class as a whole as expected values. As observed value we have used the distribution of moves for the pupils in the steering group. In this way, we reduced the possibilities of differences, as the pupils in the steering group also became part of the class as a whole.

Table 4.

Distribution of significant Chi^2 when testing distribution of pedagogical moves between the steering group and the class as a whole. Level of significance 5 %.

Class	Sender	Receiver
1		sign.
2		
4	sign.	sign.
5		
6		sign.
7	sign.	sign.
8	sign.	sign.
9		sign.
Tot	sign.	sign.

We get the same result here as for frequency of participation. Totally, we get a significant variation for both senders and receivers. Within classes, there is a variation for receivers. The same two classes that differed in freguency of participation earlier, show no significant difference in the distribution of pedagogical moves between the steering group and the class as a whole. What then distinguishes the steering group from other pupils in the class as to pedagogical moves?

Table 5.

Distribution of pedagogical moves for pupils in the steering group and for all pupils.

	Sender		Receiver	
	P_S	All	P_S	All
STR	1	1	3	16
SOL	5	10	39	39
RES	75	61	4	5
REA	18	28	46	35
HEP	1	(-)	9	5
TOT	100	100	100	100
N	376	4278	561	7218

As senders, the steering group pupils differ from other pupils in that they make fewer soliciting and reacting and more responding moves. As receivers, the steering group pupils get the same amount of questions, but more reacting and fewer structuring moves from the teacher. This pattern is somewhat bewildering. The structuring moves ought to increase more than the others, but it is quite in line with our theoretical model that these pupils make relatively more responding and HEP moves. They also get more reaction.

Before we analyze reacting moves, we shall take up the distribution of substantive-logical meaning for the pupils in the steering group versus all pupils. We report only the difference in distribution within each group. Minus value means that relatively all pupils have more moves in this category than the pupils in the steering group. Consequently, for each category, the steering group is subtracted from all pupils when the values are distributed relatively within each group.

Table 6.

Difference in relative distribution of substantive-logical meaning between the steering group and all pupils.

	Analytic		Empirical		Evaluative	
	DEF	INT	FAC	XPL	OPN	JUS
Sender	0.6	0.8	-.0.4	0.2	-1.3	0.0
Receiver	-0.1	-0.3	2.9	-0.8	-1.1	-.07

The greatest difference concerns FAC moves by receivers, where the steering group receives more fact-stating than all pupils totally. There is not the same difference for the senders. The greatest difference between the groups as regards responding is thereby tied to fact-stating.

Table 7.

Difference in relative distribution of instructional-logical meaning between the steering group and all pupils.

	Positively toned			Negatively toned		
	POS	ADM	RPT	QAL	NAD	NEG
Sender	-20.5	26.2	12.0	-0.8	-0.7	(-16.2)
Receiver	-13.8	-2.1	20.6	-3.1	-0.7	-1.1

Here we get an interesting picture (Table 7). From a relative point of view, the pupils in the steering group receive fewer negative ratings, but also fewer clearly positive ratings. Instead, the steering group pupils as senders make considerably more moves of type repeating, and especially as receivers. As these pupils steer the pace, and the teacher by questioning them knows when he can go on, it seems logical that, for the sake of control, the relative share of repeating statements should increase. This also explains why the number of responding moves increase, whitout an increase in initiating moves. Negative statements are in parantheses, as no pupil in the steering group was sender for any moves that can be classified as negative ratings. For senders, these figures must be interpreted with caution. The pupils in the steering group have only 24 moves classi-

fied as rating. Our interpretation is that the steering group pupils get direct praise, and are more often asked to repeat an earlier statement. As senders, the steering group pupils more often ask for rating than the other pupils.

Another reason for interpreting this analysis with caution is that the pupils in the steering group are here defined as the pupils in percentile 10-25 of the pupils who took the Intelligence-test. In average about 84 % of the pupils acending to the headmaster's list from the ability test. How much the other 16 % can have influenced the composition of the group is difficult to say. In any case, the role we have here described for the steering group is consistent with the pattern of correlations obtained for the steering group and various classifications of verbal behavior. In these last mentioned analyses, the absence of some pupils would not change the rank of the classes as to the value of the steering group.

Pedagogical roles extended

The constellation of frame factors and their importance in the whole is a question of how the teachers perceive and internalize these factors. It concerns how the teacher perceives the goal and the pattern of the teaching, how well he can diagnose the students' learning pace, and how well he plans the teaching in accordance with these factors and the total time available. A functional way to handle the situation, in order to save the teacher's energy, is for him to group the students within the class and give these groups different roles. If the steering group can be described in terms of the teacher's cognitive groupings of students, we get another approach for explaining the pragmatical dimension in the teaching process. These groups may constantly be changing, but each time he perceives the class, he makes such a grouping of the pupils. When time is limited and the goal fixed, these groups may be functional for the teaching and then govern the teaching process. When the time available and the goals are changed, these groups may be irrevelant to the teaching, even if the teacher cognitively still groups the students, but now on the basis of characteristics having no direct importance for their learning.

The idea we present in this discussion have been developed with the aid of Miller's (1967) theories of human information processing. Briefly, we assume that the teachers group the pupils in "chunks" with about seven students in each "chunk". The great problem lies in determining how these "chunks" form and become a cognitive "structure". Marton (1970) has developed a method for analyzing how complex information is reduced to cognitive structures. His method is based on measuring the temporal relations between units in recalling. We have used Marton's methodology on this problem.

In an interview at the end of the Spring term, each teacher was asked to name the pupils in the class. The following instruction was given:

> "This question may seem strange. Later I shall explain why I asked it. Who are the pupils in the class? Will you please name them in the order you remember them, but not in alphabetical order, and not according to how they are seated in the classroom?"

The teachers' answers were recorded, and the pause-time in seconds between names was measured with an oscillograph. From the list of pause lengths, a cumulative graph was plotted. From this graph, the cognitive groups were reconstructed. As Table 8 shows, the teacher named about six students with a short pause between each name, and then came a longer pause, followed by about six more names with a short pause in between each name. A small group of about six students was always forgotten, except by the teacher in class 7.

Table 8. The average pause-length in seconds between names within each group and between groups.

	Groups														
	1			2			3			4			5		
	Within		Between	Within		Between	Within		Between	Within		Between	Within		For-
Class	N	M		N	M		N	M		N	M		N	M	gotten
1	8	3.9	42.8	7	9.2	31.8	9	26.9	–	–	–	–	–	–	4
2	4	2.2	7.3	4	2.4	8.3	5	2.4	7.9	3	4.2	10.9	6	1.9	4
4	8	2.9	11.9	3	1.1	17.2	3	10.8	89.4	2	3.2	37.0	2	6.7	8
5	5	1.3	10.2	3	1.0	12.4	3	4.8	38.0	7	4.1	–	–	–	4
6	5	1.4	24.4	6	4.7	17.2	13	2.6	15.8	3	4.5	–	–	–	2
7	13	4.3	17.4	3	5.6	39.1	4	12.9	–	–	–	–	–	–	10
8	5	0.6	8.8	8	1.1	4.5	4	0.5	4.1	9	2.8	–	–	–	4
9	5	0.8	3.2	13	1.3	26.5	8	1.2	22.6	2	0.3	–	–	–	2

The grouping of pupils made by the teacher in each class consists of three to five groups, each group having 2-13 pupils. The average number if pupils in each group is 5.7, and the average number of forgotten pupils is 5.6. These analyses are very rough. Classifying the names that the teachers recalled into specific groups is to some extent a subjective act, as for instance, in deciding wher a pause-length may be said to belong within a group or between groups. However, in nearly all cases, the classifications were rather easy to determine, on the basis of the accumulative distribution of the pause-length.

After the teacher had recalled the names of the pupils, we asked what principle he had followed in naming them in that order, and why he associated certain pupils with others.

Probably the teachers find it impossible to recall the names of the pupils without following some kind of principle. One teacher maintains that his enumeration was made at random. Two teachers very vaguely state a principle, and four teachers clearly state a functional principle.

In two classes achievement was given as the reason for the ranking. The average WIT value for the groups also, from a relative point of view, had about the same rank order in these classes. For proportion of boys, it seems that the first group named by the teacher often has a higher proportion of boys. One teacher distinguished a clearly marked grouping as regards sex. For the average value on WIT, we find a relation if we use a signtest where plus (+) signifies that the preceeding group has a higher value, than the following one, and minus (-) signifies the lower value of the preceding group. We have omitted the "forgotten" category. We made an exception for one class, whose teacher said that he started by naming poorest pupils. There the sign is reserved for groups 1 and 2. The total distribution for 23 signs is 16 + and 7 -, which in a binomial test is significant on the 5% level. Totally, the teachers seem to group the pupils according to their intellectual ability.

Preceeding to the teachers' communication to and from these pupils, we definitely find differences between groups as regards the teaching given to the pupils. The cognitive groupings of

pupils made by the teacher reflect the roles different groups of pupils play in the teaching process. We look first at the differences in frequency of participation in the communication. In this connection, we tested the distribution of moves between the teachers' cognitive groupings, i.e., we worked out an average value for each pupil. This average value, multiplied by the number of pupils in each group, represents the expected value in a Chi^2 calculation.

Table 9. Test of differences (value of significance 5 %) in distribution of moves between teachers' cognitive groupings in the class.

	1	2	4	5	6	7	8	9
Sender	Sign	Sign	Sign		Sign	Sign	Sign	Sign
Receiver	Sign	Sign	Sign	Sign	Sign	Sign	Sign	Sign

For frequency of different moves as sender and receiver, the cognitive groupings we defined from the descriptions of the teachers differ significantly from the distribution in the class seen totally. The exception is Class 5, where the pupils as senders do not differ between the different groupings. The values we get on Chi^2 are also high, and with a few exceptions the same could apply to the .001 % level. The cognitive grouping the teacher has of the class is functional, in the sense that he behaves toward these pupils in a specific way, and these pupils in turn respond in a specific way.

Next, we look at the teachers' cognitive groupings differ as to pedagogical moves. In this connection, we tested differences in distribution of each move for these groupings. We then used the distributions showing significant differences to describe which differences exist between the groups, relatively speaking, in the distribution of pedagogical moves. The distribution differs for three moves especially - soliciting, responding and reacting.

For senders, it is naturally enough the RES move that separates the groups. One class shows no differences at all as senders. In another class, the move that sets it off from others is soliciting, and in two classes it is reacting and responding.

Table 10. Test of differences (value of significance 5%) in distribution of pedagogical moves between teachers' cognitive groupings in the class.

Class:		1	2	4	5	6	7	8	9
Sender:	SOL						Sign		
	RES		Sign	Sign	Sign	Sign		Sign	Sign
	REA					Sign		Sign	
Receiver:	SOL	Sign	Sign	Sign	Sign	Sign		Sign	
	RES						Sign		
	REA	Sign	Sign	Sign		Sign	Sign	Sign	Sign

For receivers, the soliciting and reacting moves separate the teachers' cognitive groupings. In one class, it is the responding move instead of soliciting. So far, the differences between the groupings show only that they exist in the characteristics of the pupil's role. If we consider the existing data on how the teachers' cognitive groups differ, we find almost without exception the same thing occurring for receivers, but in soliciting and reacting moves. Although the lines are not strictly drawn, we can see one group as especially important for soliciting, one for reacting and one for responding. Furthermore, we find that one group of pupils to some extent play the same role we have shown the steering group plays.

Although some teachers said they followed no principles in their grouping, we still find differences between these teachers' cognitive groupings as to their participation in the communication. In passing, we may mention that the greatest difference in the distribution between the groupings is found in the class, whose teacher denied having any principle.

In the extensive study, we asked the teachers whether they made any form of cognitive grouping in the class. 50 % of the teachers answering the questionnaire answered this question. About 90 % mention 1 to 5 groups with a certain stress (27 %) on 3 groups. The most common grouping was "active in the subject", then in the following order: talent, ambition, interest and sex.

To a certain extent, we can explain the variation in the distribution of the communication as an effect of the teacher's perception of the class and his conception of the pupils. This perception is at first not linked to each specific pupil, but the teacher groups the pupils according to the different functions they take on, and does this in order to adapt them to the aim and content of the teaching.

These analyses extend our possibilities for interpreting beyond the first tested hypothesis about a steering group. Returning back to our theoretical model the data here given both on the extensive and the intensive data verify our theory on some critical and principas points.

Teaching process and outcome

In the discussion above around classroom discourse analysis we touched upon patterns of relations shown in earlier research. In the extended surveys presented by Rosenshine (1970), Rosenshine & Furst (1971), Rosenshine (1972) and Dunkin & Biddle (1973) were few consistent patterns of relations between process and outcome shown. This does not mean that relations of this type is a vast activity to search for, but it indicates the need for a common basis on which comparisons can be made and a better theory building from which expectations can be deduced. Anyhow, some consistent patterns are shown, for example that the I/D ratio is a fairly good discriminator; that the teachers' warmth and supporting behavior is of importance for knowledge development. The few relations established in several studies point to some extent toward a pattern of teaching that very clearly appears in the above shown relations between the ability of the steering group and the process.

The classes investigated were given a test of knowledge in Mathematics during the Spring term. This test had a high content validity in relation to the actual content of the teaching (Rångeby 1973). In order to mirror the relations between teaching process and learning outcome we calculated the correlations between the relative distribution of different categories within each class and the mean on the test.

From the theoretical discussion we can deduce following hypothesis: Patterns of relations between measures of outcome and different categorizations of the process is correspondent to the pattern of relations between steering group and categorizations of the process.

Totally the correlation between process and outcome shows few significances. The number of significance is lower than 1 % on the corresponding level. So far no interpretation could be done. Even if we divide the test into items and look on the correlation between results on the specific items that correspond to the content actually taught during the observed period, no difference appears (cf Rångeby 1973).

In looking on the direction of the correlations we find that about half of the correlations are negative and about half of our correlations are positive.

But when looking on the direction of correlations for the variables that showed a significant correlation between the steering group and the process, an interesting pattern appears. We have here of technical reasons (cf Rångeby 1973) used 20 significant correlations. Of these correlations, one is zero of the remaining nineteen (19) fifthteen (15) correlations go in the same direction (table 11), even if not significant, when calculated between the process and the outcome.

Table 11. Correlations between steering group and process and correlations between process and outcome which in one of the two relations is significant.

Steering group (R_p)	Process variables	Outcome
.88	Number of moves/lesson	.53
.88	Responding moves (RES)	.28
-.80	Individual help (HEP)	-.21
.93	SOL-initiated cycles	.25
.82	SOL, RES-cycle	.40
.31	SOL, REA-cycle	.89
.64	SOL, RES, REA-cycle	-.04
.69	Subject-relevant moves	.19
-.64	Number announced moves	-.35
.71	Positive ratings (POS)	.49
-.68	Negative ratings (NEG)	-.01
-.73	Teacher informing	-.11
.82	Teacher. Leading discussion	-.01
-.90	Informing. Gives opinion	-.25
.54	Narrow Questions. Teacher	-.04
.67	Accepts Ideas. Teacher	-.01
-.48	Unpredictable answers. Pupil	-.50
.69	Shows solidarity	.00
.19	Shows tension	.74
.81	I/D ratio	.03

This table (table 11) supports a verification of the hypothesis. The steering group influences the pattern in a certain way. The higher level the steering group has, the more effective is the teaching in relation to test of achievements. An increasing level of the steering group seems to make it possible to form rules for the classroom language, which are more effective. Or interpreted further; to make differences on the "parole" level.

Chapter 5. Future research lines

The study here presented opens up an avenue of inquiries. The most dominating question, seems for me to be, how to develop a formalization of this theory. Within that work empirical analysis must be done on critical points.

This work is now planned in several steps. The first step is to express the theory more clearly. Pinpoint the basic assumptions and logically by deduction relate different concepts to each other (cf Lundgren 1973). The second step is to start with some variables and assume, on basis of earlier research, the relation between them. The most obvious is to start with the frame factors, for example the size of the class and the composition of the class and how these too variables are interrelated and steer the process. When formalized, we make a modelled system. As we are here working very dynamic relations, we have to leave the level of simple statixtical models. In order to develop the formalization we must build the model with the aid of a data computer. The second step will include also a simulation model building (of Norlén 1972). With the aid of simulation we can work out a hypothesis, which can be empirically tested. When a hypotheses is not verified we can simulate parts of the system and modify the basic assumptions. This work procedure will be done on already collected data and on some parts of the system. When a modelled system is fitted so that it explains this mass of data we will go over to the third step.

This step will be to use earlier collected data, where the frame constellation is quite different from the one used in this study. In this phase we also have to reclassify the observation of teaching from a more comprehensive theoretical approach. From the theory we can deduce hypotheses and test and modify our model. This way of working is extremely hypothetic-deductive in its character and will both mean a formalization of our theory and empirical verification. Obviously there are masses of raw data already collected and the methodology here represented forces us to use data collected outside Sweden. On a more genereral level this way of working is a spare of time and money.

The first three steps are the most important to take and will function as an umbrella for the development of our theory.

Parallel to this work there is two other approaches that will be used.

The first is to more theoretically mirror the relations between the process and the outcome. We will here go another way round (cf Kilborn & Lundgren 1973).

A test of knowledge in arithmetic has already been developed, from which each student can be diagnosed in relation to a structured plan over different areas within arithmetic. From this plan we can within each item diagnose what part of the plan the student masters. The design will be to give a pre- and post-test and the process will be followed and coded both according to the plan and the students' linguistic competence. We can here analyze how the teaching is steered in relation to pre-knowledge, how the students interact, what educational role they will have and the learning outcome for the students. In the design we have planned experiments to vary frames as well as teachers. To some extent this approach can be looked upon as similar to the approach recommended by Gage (1972). It is in some respect, but it is not in a very significant way. The whole approach is steered by a comprehensive theory. The approach is built in the first hand on deduction, not induction.

The other way is quite contrary. The way we here treated the theory is on an epistomological level to some extent traditional. The analysis will lead us to explain relations between variables and to some extent to understand a process, but we have left the more structuralistic analysis. This would mean another approach in which we try to analyze the teaching process as a system of transformation with a specified purpose. On an epistomological level we have more to analyze then what the teaching structure (cf Andersson 1969) and on an empirical level try to build up a more hermeunetic approach.

As we have planned the next step, it consists of formalising the model, to test different parts by use of earlier and new data, by field studies and by experiments. But on the same hand we must

loose up the model and try a more comprehensive thinking for mirror the teaching process not only as a set of rules mixed by parts, but also as a set of rules steered by intention and purpose, in which the student is looked upon not only as a reacting organism on different stimuli but as a generating organism with planned actions.

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